MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

EEL3156 – RENEWABLE ENERGY TECHNOLOGY

(LE)

27 MAY 2019
2:30 p.m–4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 5 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Define renewable and non-renewable energy. Provide TWO examples for each of the type of energy. [8 marks]

(b) Explain the basic principles of how pumped storage hydropower system works. [5 marks]

(c) State the energy conversion performed by a wind turbine. Then, list THREE advantages of horizontal axis wind turbine and vertical axis wind turbine each. [7 marks]

Question 2

(a) Solar energy can be harnessed either thermally or through photovoltaic technology. Explain:
(i) TWO systems used to harness solar thermal energy [4 marks]
(ii) the basic principle of how photovoltaic technology works [4 marks]

(b) Biomass are organic matters used as energy source.
(i) List THREE types of biomass [3 marks]
(ii) State THREE challenges associated with solid biomass [3 marks]
(iii) List THREE advantages of biogas being used as biofuel [3 marks]

(c) Describe geothermal energy. [3 marks]

Continued ...

Question 3

(a) Water from a reservoir flows at 2 m^3/s down a smooth and vertical penstock pipe of length 10 m.

(i) Determine the maximum power available at the source. [4 marks]

(ii) Recommend a practical way of increasing the maximum power generation. [2 marks]

(iii) Analyse the scenario at which reaction turbine is more applicable than impulse turbine. [7 marks]

(b) A researcher is estimating the maximum available wind power in three cities. Analyse Table 3 (b) and rectify the estimation if needed. [7 marks]

Table 3(b): Wind power in 3 cities

City	Air density (kgm^{-3})	Radius of wind turbine (m)	Wind speed (ms^{-1})	Wind power (W)
A	1.2	3	2	136
B	1.2	4	5	3770
C	1.2	3	8	8686

Question 4

(a) You were approached by a client to design a solar photovoltaic (PV) system for his house. The house is on the top of a hill in a remote area which is 300km away from the main power grid.

(i) Analyse the aforementioned situation and decide whether you should design a standalone system or a grid-connected system. Justify your choice. [3 marks]

(ii) In another project, you were instructed to design a standalone PV system. You were given the following parameters: battery efficiency (87%), PV array efficiency (75%), total load ($7kWh$), shading factor (0.95), tilt orientation factor (0.85), peak sun hours (4.5) and module rating ($195W$). Determine the number of modules needed. [7 marks]

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(b) Figure Q4(b) shows a hot dry rock site suitable for geothermal energy harnessing.

(i) Calculate the useful heat content per square kilometer of the hot dry rock. The minimum useful temperature is 100 K above the surface temperature T_0, rock density, $\rho_r = 2700$ kg m^{-3}, and rock heat capacity, $c_r = 820$ J kg^{-1} K^{-1}. Given that the depth $z_1 = 2.5$km and $z_2 = 5$km. [4 marks]

(ii) Calculate the useful heat extraction rate initially and after 10 years if the time constant= 1.84 x 10^9 s. [6 marks]

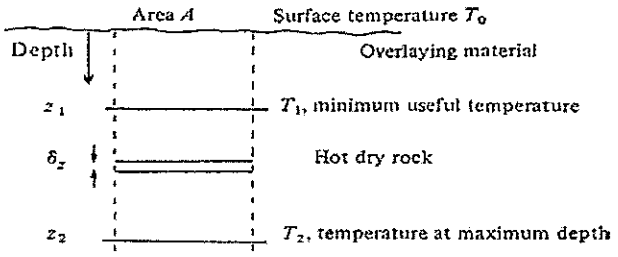

Figure Q4(b)

Question 5

(a) Examine the challenges in integrating wind power to the main grid. [3 marks]

(b) Solar farms are large-scale photovoltaic system designed for the supply of power into the utility grid. State and analyse THREE factors which should be considered before building a solar farm. [6 marks]

(c) Energy storage system significantly aids the integration of renewable energy to the utility grid. State THREE energy storage options that are predominantly used. [3 marks]

(d) It is crucial for the energy supply and demand to be matched. Explain THREE control strategies that can be employed to ensure good matching of renewable energy supply to end-use demand. [8 marks]

End of the Paper